# Chapter 1
# Introduction to Life and Evolution

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During the last decades, increasing attention has been paid in Latin America to the history and philosophy of biology. As attested by the creation and growth of many specialized journals, many scholars have actively engaged in this field, producing high-quality research. Although several authors regularly publish in English, most of them still prefer to write in Spanish or in Portuguese and, for this reason, their ideas have barely crossed the boundaries of the continent. This book aims to remedy this state of affairs, by offering to the international reader a collection of original articles by some of the most skillful historians and philosophers of biology currently working in Latin American universities.

The invited authors have been chosen following three main criteria. First of all, of course, the excellence of their work. They all have published in well-established peer-reviewed journals and have either promising or already recognized academic trajectories. Secondly, we have attempted to maximize the geographical representativeness: among the invited authors, there are researchers from Argentinian, Brazilian, Chilean, Colombian, and Mexican universities. Finally, in order to preserve a plurality of perspectives, we have carefully selected scholars with somehow different intellectual backgrounds: some of them are philosophers of science or epistemologists, while others have a formal education in biology or other scientific fields and a keen interest for the history of science.

Notice that our emphasis on the regional provenance of the invited authors is not intended to suggest the existence of something like a Latin American history and philosophy of biology, supposedly endowed with distinctive features. On the contrary, we firmly believe that advances in this field can be achieved only by stimulating the integration of local authors into the international debate. Accordingly, we have selected as central themes of the book two topics, that is, life and evolution, which are at the same time representatives of the interests of our invited authors and of the worldwide community. Regarding the first topic, the book includes contributions ranging from the history of the concept of life to the philosophical reflection on life manipulation and life extension while, concerning the topic of evolution, it includes articles on the structure of evolutionary theory, its historical development, and human evolution. In order to ensure the book's coherence and impact, we encouraged the authors to explore, as far as possible, connections between the two topics and engage in debates with each other as well as with leading international researchers.

Of course, a book of this kind – aimed to reflect a plurality of perspectives more than attain some unitary goal – inevitably entails a certain degree of heterogeneity. We hope that the reader will be able to appreciate our effort for bringing different views and conceptions together, forgiving us for some conceptual leaps between chapters. While our selection of authors is certainly representative of the geographi- cal, disciplinary, and theoretical differences in the area, it is sadly also representa- tive of the limited presence of women in the field. In spite of the fact that some of the most important contributions to the diffusion of the history and philosophy of biology in Latin America were made by women (see next section), the field is still prevalently masculine. Actually, in many Latin American countries this situation is common in many areas of philosophy. We sincerely hope that this state of affairs may change in the near future.

In the remaining of this introductory chapter we first sketch a brief history of the history and philosophy of biology in Latina America and, then, we discuss in more detail the content of the authors' contributions.

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## 1.1 The History and Philosophy of Biology in Latin America

The institutionalization of the history and philosophy of biology as autonomous disciplinary fields is relatively recent in Latin America. Although historical and philosophical reflections on biological subjects and practices were not completely absent in the previous decades, it is only from the 1990s that scientists, historians, and philosophers of science started to pay systematic attention to conceptual issues surrounding genetics, evolution, and development.

Mexican scholars played a prominent role in the creation of academic platforms aimed to promote the debate in this area of knowledge. The Institute for Philosophical Investigations of the National Autonomous University of Mexico (UNAM - Mexico City) was possibly the first institution to organize research activities related to the history and the philosophy of biology in the region. This academic ferment resulted in a series of milestone publications, such as *Historia y explicacion en biología* ("History and Explanation in Biology"; Martínez and Barahona 1998), in which original essays by Latin American historians and philosophers were collected along with Spanish translations of classic works by Richard Lewontin, Ernst Mayr, Stuart Kaufmann, and David Hull (among others).

The creation of a research group on evolution and cognition in the Centre for Philosophical, Political and Social Studies Vicente Lombardo Toledano (Mexico City) led, in 1999, to the publication of the first Ibero-American international journal entirely dedicated to the philosophy of the life sciences, *Ludus Vitalis*.[1] In the same year, Oaxaca was the venue of the second congress of the International Society for the History, Philosophy and Social Studies of Biology (ISHPSSB). These two circumstances greatly contributed to the further diffusion of the debate and the professionalization of the disciplinary field in Mexico and in other Latin America countries, especially Colombia, Brazil, and Argentina.

From the intellectual exchange of scholars from these countries (among them, Gustavo Caponi and Alejandro Rosas, who have both contributed to the realization of the present book), the first Latin American international network of history and philosophy of biology emerged in 2004. It was called the *Bogotá group*, and organized meetings until 2012. In that year, the members of the Bogotá group, along with colleagues from Spanish universities, founded the Ibero-American Association of Philosophy of Biology (AIFIBI). The first congress, in Valencia, counted with the participation of many researchers from both sides of the Atlantic. The second and third congresses, respectively in Valle de Bravo (Mexico) in 2015 and in Bogotá in 2018, further consolidated the Spanish and Portuguese speaking community of historians and philosophers of biology.

Other, both national and international, associations contributed to this goal. The most notable are possibly the Brazilian Association of Philosophy and History of Biology (ABFHiB) – whose current directorship includes two contributors of the present book (Charbel Niño El-Hani and Lilian Al-Chueyr Pereira Martins) – and the Association for Philosophy and History of Science of the South Cone (AFHIC). ABFHiB has been organizing regular meetings since 2006. In 2017, it offered the logistic support for the ISHPSSB congress in São Paulo. ABFHiB also edits a biannual specialist journal, *Philosophy and History of Biology*. Although more generally oriented towards the history and philosophy of science, AFHIC, which has been organizing congresses every 2 years since 1998 in different countries of South America (Brazil, Argentina, Uruguay, Chile and, in 2020, Colombia), has provided an important platform for stimulating the debate in the history and philosophy of biology.

From this intense research activity several noteworthy publications have stemmed. Among the most influential monographies, we find, in Mexico, *La explicación teleológica* ("The Teleological Explanation") by Margarita Ponce (1977), *El método de la ciencia: epistemología y darwinismo* ("The Method of Science: Epistemology and Darwinism") by Rosaura Ruiz and Francisco Ayala (1998), and *El sesgo hereditario* ("The Hereditary Bias") by Carlos López Beltrán (2004). Outside Mexico, especially notable are *La ontogenia del pensamiento evolutivo: hacia una interpretación semiótica de la Naturaleza* ("The Ontogeny of Evolutionary Thinking: Towards a Semiotic Interpretation of Nature") by Eugenio Andrade

[1]Actually, the Centre had been previously publishing another journal, *Uroboros*, discontinued in 1997.

(1998), *Leyes sin causa y causas sin ley* ("Laws without Cause and Causes without Law") by Gustavo Caponi (2014), and *La teoría de la selección natural: una exploración metacientífica* ("The Theory of Natural Selection: A Metascientific Exploration") by Santiago Ginnobili (2018), to mention just a few.

As examples of the collective books edited over the last years, we can moreover cite *Filosofia da Biologia* ("Philosophy of Biology"; Abrantes 2011), which collects in Portuguese an impressive selection of articles written by the members of the Bogotá group, or *Darwin's Evolving Legacy* (Martínez-Contreras and Ponce de León 2011), a book aimed at promoting an interdisciplinary debate between biologists, historians, and philosophers. Besides the already mentioned *Ludus Vitalis* and *Philosophy and History of Biology*, many other Latin American journals dedicated to the general history and philosophy of science have paid great attention to the debate in the history and philosophy of biology. Among them, the most important are possibly *Scientiae Studia* in Brazil (which included in its editorial board many of the authors of the present book), *Revista colombiana de filosofía de la ciencia* in Colombia, and *Metatheoria* in Argentina (whose chief editor, Pablo Lorenzano, is one of the contributors of this book).

## 1.2 Content of the Book

Although the articles here collected are to a considerable extent heterogeneous, we have attempted to maximize the coherence of the volume by starting from the most historical contributions, proceeding progressively to the most philosophical ones. In this section, besides summarizing the content of each chapter, we shall draw some connections between them.

Lilian Al-Chueyr Pereira Martins opens the book with a discussion on the important controversy over biological inheritance that took place in Great Britain at the beginning of the twentieth century between the Mendelians, headed by William Bateson, and the biometricians, headed by Walter Frank Raphael Weldon and Karl Pearson. As it is well known, the biometrical school advocated a theory of blending inheritance grounded on Galton's law of ancestral heredity, whereas the Mendelians interpreted the units of biological inheritance as discrete particles, i.e. the genes. While biometricians supported their thesis by employing sophisticated statistical methods, the Mendelians privileged experiments with hybrids obtained through crossings with animals and plants. Through the analysis of a rich and extensive bibliographical material – including published and unpublished manuscripts and correspondence – Pereira Martins investigates the role that the struggle for *authority* played in the controversy. She focuses especially on the figure of Weldon and on his late attempt of reconciliation between Mendelism and biometry. In Pereira Martins' opinion, the fact that Weldon admitted the possibility of such reconciliation only towards the end of his life supports the claim that one of the main factors that originally motivated the controversy was the desire, of the leading figures of Mendelism and biometry, to obtain supremacy in the field of heredity and evolution.

In Chap. 3, Ronei Clécio Mocellin and Luciana Zaterka present a discussion on the relation between "blood, practice of transfusions and longevity" from modernity to the present days. From the investigation of three historical episodes in which blood transfusions were associated with the fight against senescence, they argue about the existence of a common epistemological research program. This is the application of what the authors call the "Baconian research program." The first episode concerns the metaphysical-theological foundation of this program, especially in Francis Bacon and Robert Boyle's works, and the reasons that subsequently led, in the second half of the seventeenth century in France, to the abandonment and even the banning of blood transfusions. The second historical study highlights some ideas and practices carried out by the Russian doctor and philosopher Alexander Alexandrovich Malinovsky-Bogdanov, the director of the first world institution exclusively devoted to the study of blood and transfusion. The last historical study deals with the contemporary concept of blood, especially in the context of the philosophical movement known as transhumanism.

Maurizio Esposito and Gabriel Vallejos Baccelliere, in Chap. 4, analyze the so-called *performative* epistemology (Pickering 1995). From this perspective, the philosophical focus is on how "reality" or "nature" are technically and materially mastered and tamed. Science is a collection of practices and not just a theoretical enterprise. Throughout the text, the authors spell out the epistemological consequences of this methodological position. In a scientific world where entities are not just thought or represented but touched, used and transformed, the question about their existence does not really matter. What does matter is, rather, to what extent we can understand, through our experimental

practices, how natural processes work. By assuming the centrality of this question, Esposito and Vallejos highlight four principal aspects of experimental practice: constrained action, standardization, epistemic "tightening," and extrapolation. Altogether, these points chart what they call the Epistemic Experimental Space (EES), i.e. the abstract space in which experimental knowledge is produced, assessed, and validated. The authors show how the integration within this space makes experimental knowledge in biology a highly consistent, reliable, and successful epistemic activity.

By adopting an organizational perspective on ecological systems, Charbel Niño El-Hani and Nei Nunes Neto investigate, in Chap. 5, how the transition from a physicochemical to a life-constrained world occurred. In their opinion, this transition can be conceptualized as a passage from a closure of processes to a closure of constraints in the ecological realm. While processes produce physicochemical changes, constraints are entities that act upon processes, reducing their degree of freedom while remaining unaffected by them (Moreno and Mossio 2015). After having offered a detailed elucidation of these concepts, the authors illustrate the passage from a closure of processes to a closure of constraints through a discussion of the CLAW (so called after their proponents, Charlson, Lovelock, Andreae, and Warren) hypothesis. The CLAW hypothesis explains the production of clouds over the oceans, affecting climate at a global scale, as the result of a coupling between the physicochemical flow of matter and the activity of living systems. El-Hani and Nunes Neto argue that this is a good example of what happens in the transition from an abiotic ecological to a "life-constrained" ecological system and, thus, support our understanding of the role of life on Earth.

In continuity with this discussion, Alejandro Rosas and Juan Diego Morales face up, in Chap. 6, one of the most formidable problems of modern philosophy since Kant, that is, the emergence and the nature of purposiveness, or teleology, in living beings. The authors approach the question drawing on the recent work of the chemist Addy Pross (2012). According to Pross' view, the origin of life is to be found in certain interactions between three molecular structures: replicators, metabolic enzymes, and membranes. The subsequent evolutionary steps involved tentative complexifications of these interactions, followed by the natural selection of the most stable chemical networks of reaction. Rosas and Morales notice that, throughout this gradual process, it is crucial that associations between molecules provide mutual benefits. In their opinion, this corresponds to a primitive case of cooperative dynamic. Cooperation, in its turn, involves goals. In the case of molecules, the shared goal is to maintain *wholes* that guarantee their persistence by drawing energy from the environment and replicating. The self-maintenance of the wholes is not merely an effect of the interaction between the molecules but, compatible with Kant's characterization of a "natural end," it is itself a *cause* of the behavior of the molecules. It is hard to say at which stage of the integration of the molecules within the wholes teleology actually emerges, but Rosas and Morales confidently argue that teleology is not an apparent but a real feature of the organic world.

The topic of Chap. 7, by Maximiliano Martínez, Alejandro Mosqueda, and Jorge Oseguera, is the relation between evolution and moral realism. The so-called debunking argument, put forward by some naturalist philosophers, is aimed to show that natural selection and moral realism are incompatible. From the very same naturalist standpoint, the authors of the chapter aim to challenge such a conclusion and argue that moral realism can be scientifically grounded. In order to develop their account, Martínez, Mosqueda, and Oseguera take as their critical target Street's version of the debunking argument (Street 2006). According to Street, the main problem of moral realism is that it needs to postulate moral truths that are independent of our evaluative attitudes. Moral behavior in our species would be a consequence of the fact that natural selection made us track moral truths. Yet, Street considers that an alternative anti-realist explanation, which does not invoke independent moral truths, is possible, more parsimonious and, thus, naturalistically preferable. Martínez, Mosqueda, and Oseguera's overall strategy against Street's argument consists in showing that moral realists do not need to commit themselves to the existence of independent moral facts, but just to independent *evaluative* facts. From an evolutionary perspective, these facts can be considered as facts about what increases fitness in specific circumstances. Explanations of moral behaviour invoking this kind of facts are not less parsimonious than the anti-realist ones and, thus, moral realism is not debunked.

Gustavo Caponi discusses, in Chap. 8, the analytic relations between three fundamental concepts of the theory of natural selection, that is, the concepts of biological function, fitness, and adaptation. He assumes that the concept of adaptation needs to be analyzed in terms of the concept of fitness and, in its turn, the concept of fitness needs to be analyzed in terms of the concept of biological function. Caponi holds that

this task can be made easier if we consider these three concepts as speci- fications of other three broader concepts. These are, respectively, the concept of function, the concept of effectiveness, and the concept of design. The main goal of the author is to show how the theory of natural selection interprets and connects these notions so as to provide a solid framework for a naturalization of teleology (a topic that, besides being the subject of Chap. 6, will return in Chap. 11). The corner- stone of Caponi's analysis is his interpretation of the notion of function as a causal role (derived, but with some important differences, from Cummins 1975). This interpretation is developed in opposition to the etiological conception of function (Wright 1973). In Caponi's view, the etiological conception leads to unavoidable circularities. On the contrary, insofar as it clearly distinguishes between function and *raison d'être*, the causal role conception allows a straightforward naturalistic analysis of the notion of effectiveness and, indirectly, of design.

In Chap. 9, Lorenzo Baravalle and Davide Vecchi take side in the long-standing controversy between causalist and statisticalist interpreters of evolutionary theory. More specifically, they argue for a dynamical view, according to which selection, drift, migration, mutation, and the other factors of evolution are not just causes, but may be considered as *forces* of evolution. In order to support this claim, they focus their analysis on one of the most controversial evolutionary factors, that is, genetic drift. Baravalle and Vecchi first argue that drift is a cause because the evolutionary explanations invoking events instantiating drift processes are, compatibly with Woodward's (2003) manipulationist account of explanation, causal. Then, they argue that the function of the concept of drift in such explanations is precisely that of unifying sundry events in accordance to the specific causal role that they play in a certain evolutionary scenario. Following Hitchcock and Woodward (2003), Baravalle and Vecchi characterize the explanations in which analogous unificatory causal concepts appear as *deep explanations*. They thus observe that force- explanations in Newtonian mechanics are, in a sense, nothing more than a kind of deep explanation. They are deep explanations because the notion of force plays in them a causal unificatory role. On the base of this common explanatory function, the authors conclude that drift can be considered as a force.

Within the heterogeneous family of the semantic approaches to the structure of scientific theories, metatheoretical (or Sneedean) structuralism is certainly the one that has been most developed and refined in Latin America (Diez and Lorenzano 2002). Pablo Lorenzano and Martín Andrés Díaz show, in Chap. 10, how it can be employed in philosophy of biology to solve old problems related to the existence of biological laws, the relation between biological models and theories, and theoretical unification in biology. After having introduced some of the main conceptual tools of metatheoretical structuralism, Lorenzano and Díaz sketch a structuralist reconstruction of a biological theory, i.e. population dynamics. They thus argue for the existence of a "first law" of population dynamics, that is, a *guiding principle* that heuristically orients the theoretical work of population dynamicists by pointing out what class of circumstances is indissolubly related to the phenomena under study. The guiding principle coordinates the models that population dynamicists formulate, in order to account for specific factors influencing demographic processes, within a unified theoretical framework. Through this analysis, Lorenzano and Díaz show that, in spite of their specificities, biological theories do not structurally differ from physical ones.

Another application of metatheoretical structuralism is provided in the last chapter by Andrea Soledad Olmos, Ariel Jonathan Roffé and Santiago Ginnobili. Here the goal is to test whether the reduction of functional language developed by systemic analysis is successful. To this aim, the authors first outline the theoretical structure of systemic analysis. This reconstruction guides the subsequent critical discussion. Olmos, Roffé, and Ginnobili raise two main concerns about the adequacy of the systemic approach. The first one is related to its comprehensiveness. The authors argue that although the systemic approach is fruitful to account for some portions of biological practices (especially in areas such as molecular biology, neuroscience, and neuroethology), it cannot adequately explicate the notion of biological function in all its uses. The second concern refers to the explanatory strategy grounding functional systemic analyses. In a systemic analysis, structure is taken to explain function. By contrast, Olmos, Roffé, and Ginnobili argue that in functional explanations it is function that explains structure. In sum, they show that, while it is true that systemic analysis is an important component of functional attributions, it does not by itself account for the use of functional language in biology.

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